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Land Snails of the Cheat River Canyon, West Virginia (Gastropoda: Pulmonata)

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ABSTRACT

The rich land snail fauna of the Cheat River Canyon in Monongalia and Preston counties, West Virginia, is reported. Sixty-six species were found in a 26 km segment of this steep-sided, forested valley. Snails of potential conservation interest include the central Appalachian Mountain endemics *Patera panselenus*, *Paravitrea petrophila*, *Stenotrema edvardsi*, and *Ventridens arcellus*, as well as the globally rare Cheat River Canyon endemic *Triodopsis platysayoides*. Other snails of possible local conservation interest are *Hendersonia occulta* and *Vertigo bollesiana*.

Key words: Cheat River Canyon, *Hendersonia occulta*, land snail, *Patera panselenus*, *Paravitrea petrophila*, *Stenotrema edvardsi, Triodopsis platysayoides, Ventridens arcellus, Vertigo bollesiana*, West Virginia.

INTRODUCTION

The Cheat River Canyon is a forested, steep-sided river valley in northern West Virginia. Efforts to locate and conserve the globally rare *Triodopsis platysayoides* Brooks, 1933, as well as other work to inventory natural resources on state and private lands over the past decade, have led to the discovery of a rich land snail fauna here. First collected at Coopers Rock near the north end of the canyon by M. Graham Netting of the Carnegie Museum of Natural History, *T. platysayoides* inhabits parts of the forested rock outcrops, boulder talus, and cave entrances within the northern three-quarters of the 26 km (16 mile) canyon. The canyon also provides refuge to a variety of central Appalachian Mountain endemic and rare species, including other land snails discussed below, plants, bats (including Indiana Bats [*Myotis sodalis*]) and other small mammals, amphibians, reptiles, and cave-dwelling aquatic invertebrates (West Virginia Division of Natural Resources, unpublished data).

Logging for charcoal and lumber, and associated small gauge railroad and road building, has affected most of the canyon at one time or another. Past strip mining of coal on the surrounding plateau has also altered slope drainage patterns. Despite these impacts, many areas have apparently escaped more intensive use due to their steepness and rock features, and large

portions of the canyon forest have regenerated. However, in some parts of the canyon ongoing steep slope logging, skid trail and haul road development, and the spread of nonnative invasive plants such as Tree of Heaven *Ailanthus altissima* (Millspaugh), continue to change forest habitats.

Land snail inventory in West Virginia has been widespread, yet rarely intensive. Brooks & Kutchka (1938; later MacMillan, 1949) did early work on the state's Pupillidae. MacMillan (1949) monographed the state's entire land snail fauna, aided by a network of regional collectors. Approximately 160 species were recognized in West Virginia by Hubricht (1985), who collected throughout the eastern United States. The species-rich family Polygyridae was the focus of statewide work by Counts (1977) and some West Virginia collections are part of Emberton's work on Triodopsinae (1988) and Mesodontini (1991). In a rare example of geographically-intensive inventory, Taylor & Counts (1976) reported on the snails of Blennerhassett Island on the Ohio River.

STUDY AREA

The Cheat River drains more than 3,600 km^2 of the Appalachian Plateau in northeastern West Virginia, flowing north and west toward the Ohio River Valley. Watershed elevations range from approximately 1,500 m at its southern reaches, to 235 m at its confluence with the Monongahela River. The Cheat River Canyon, West Virginia, for purposes of this paper, is defined to be the approximately 26 km stretch from Albright, Preston County, downstream to Cheat Lake, Monongalia County (Figs. 1, 2). Elevations of ridgetops above the canyon rim range from 640 m (e.g., above Hacklebarney Run and at Coopers Rock and Snake Hill) to 268 m at Cheat Lake. The geology of the canyon consists of a series of Pennsylvanian and Mississippian age sedimentary rock strata deposited 300-350 million years ago (Cardwell et al., 1968). Pottsville Sandstone occurs at higher elevations, sometimes outcropping above steep slopes, and Pottsville talus is widespread on slopes all the way to river elevation. This formation is underlain by the softer, often reddish, Mauch Chunk. Beginning near Kingwood and continuing downstream, gray or whitish Greenbrier Limestone appears at mid-to-lower elevations, where caves and a variety of marine fossils occur. Mauch Chunk and Greenbrier outcrops and ledges are also frequent on steep slopes, at the head of debris chutes, and along ravines. Lowest are strata of Purslane (Pocono) Sandstone. The slopes of the Cheat River Canyon are mostly forested, with oaks (*Quercus* spp.) dominating drier sites, and cove hardwood or

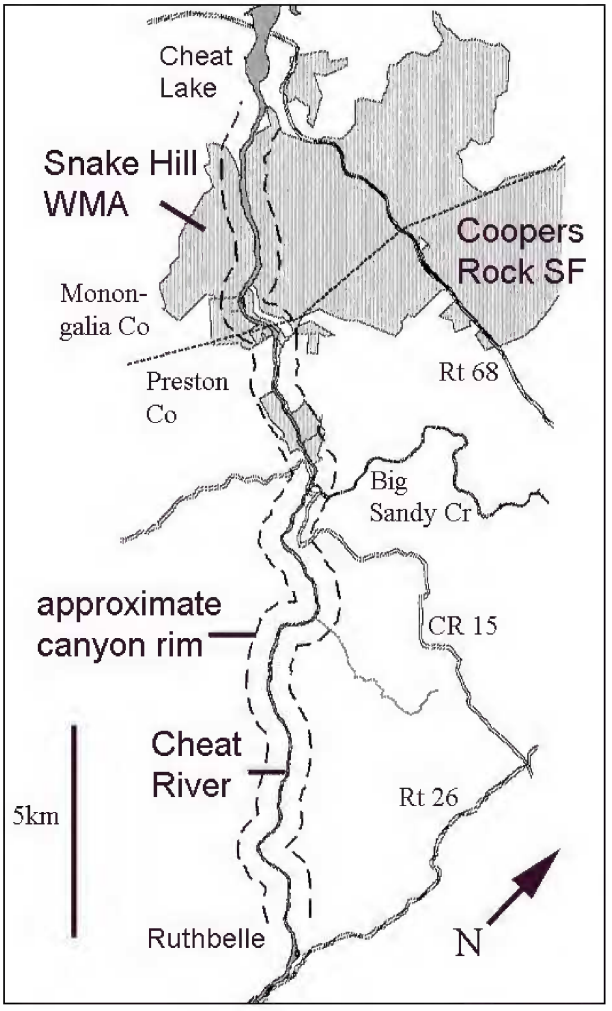

Fig. 1. Schematic map of the Cheat River Canyon, West Virginia. Public lands are shaded.

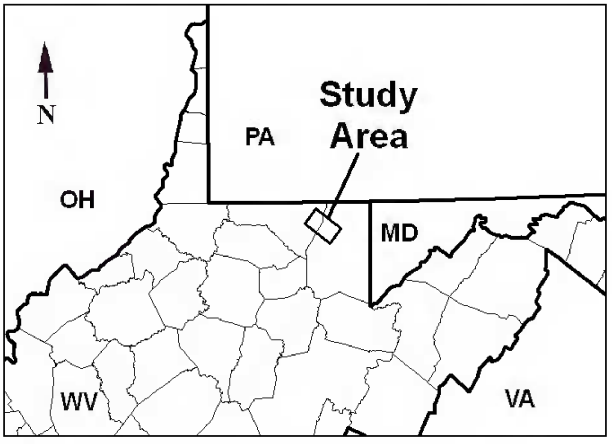

Fig. 2. A regional map of the study area.

Eastern Hemlock (*Tsuga canadensis* (L.) Carr.) stands in stream valleys and lower slopes. Understories sometimes include large stands of Great Laurel (*Rhododendron maximum* L.). Further description of the vegetation appears in Hotopp (2006).

METHODS

We conducted land snail inventories in the Cheat River Canyon from 1997 to 2006 (KPH), in 2004 (TAP), and in 2006 (DCD). Much of this inventory was incidental to work on the federally threatened *T. platysayoides* on state and private lands. These lands were those of Coopers Rock State Forest, Snake Hill Wildlife Management Area, and Allegheny Energy (of which parts are now owned by the state and a private timber company), totaling approximately 4,000 ha. Also, KPH inventoried land snails at the mouth of Cornwell Cave in 1998, at that time on Allegheny Energy property managed in cooperation with the West Virginia Chapter of The Nature Conservancy.

Snail collection was often focused on rock outcrops and talus where *T. platysayoides* might be found, but extensive collection during foot travel to and from rock features was also conducted. We visually inspected features such as tree trunks, coarse woody debris, herbaceous vegetation, and tree crotches, often with the aid of a flashlight. Sandstone and shale outcrops and overhangs, and limestone outcrops and cave entrances were frequently explored. Leaf litter was sometimes collected, in plastic bags, then later dried and sorted for land snails with the aid of a magnifying visor. Live land snails (except *T. platysayoides*) were drowned in tap water for 24 hours and then preserved in 70% ethanol. Land snails were identified using Emberton (1988, 1991), Hubricht (1976), and Pilsbry (1940-1948). Our taxonomy follows Millard (2003) and Roth (2003). Voucher specimens were deposited in the Carnegie Museum of Natural History mollusk collection (CM 67453, 67243-67256, 67280-67370, 67496-68689, 69815-69831, 70585-70725, 72574-72643, 73102, 73975-73989).

RESULTS

We documented 66 land snail species in the Cheat River Canyon, including many species of Polygyridae (13), Zonitidae (11), and Gastrodontidae (10) (Table 1). Distribution patterns of land snails varied greatly, with some species common and widespread, whereas others were restricted. While we did not quantify specific geographic distributions or associations between land snails and habitat, we offer here some qualitative observations.

Among the most abundant and widespread larger snails were *Mesomphix inornatus* (Say, 1821) and *Triodopsis tridentata* (Say, 1816), common in oak (*Quercus* spp.) and Sweet Birch (*Betula lenta* L.) leaf litter. *Angulispira alternata* (Say, 1816) was widespread. *Mesomphix cupreus* (Rafinesque, 1831) and *Neohelix dentifera* (A. Binney, 1837) were often found on mesic sites. *Stenotrema hirsutum* (Say, 1817) colonies were in mesic sandstone talus. *Appalachina sayana* (Pilsbry, 1906) and *Allogona profunda* (Say, 1821) were encountered on or near Greenbrier limestone, which was sometimes buried beneath sandstone talus. Large philomycid slugs were encountered in many places, but especially on poor soils, often with *Tsuga canadensis* and sandstone. *Discus patulus* (Deshayes, 1830) and *Strobilops* spp. occurred in typical colonies upon snags and woody debris. Tiny leaf litter snails were widespread but species richness was obviously greater on sites of middle-to-lower canyon elevations.

Regarding snails of potential conservation interest, *Triodopsis platysayoides* was found in more than 70 locations in the northern three-quarters of the canyon. These locations were mainly Pottsville sandstone features, both cliffs near the canyon rim, and talus locations at various elevations between the canyon rim and the river. The snail was also found in three places in or near Greenbrier limestone fissures. Most sites were forested and frequent woody plant associates were *Betula lenta* and *Rhododendron maximum*. Detailed field observations were provided to the West Virginia Division of Natural Resources.

Hendersonia occulta (Say, 1831) was found in the leaf litter at only a single Greenbrier limestone location in the southeastern part of the canyon. *Vertigo bollesiana* (E.S. Morse, 1865) (Fig. 3) also occurred in leaf litter in the same area on a few rich sites. The Appalachian endemics *Paravitrea petrophila* (Bland, 1883) and *Stenotrema edvardsi* (Bland, 1856) were encountered uncommonly, in forest litter on rich sites. *Ventridens arcellus* Hubricht, 1976 was found in litter on steep slopes. *Patera panselenus* (Hubricht, 1976) was patchily distributed, apparently restricted to damp rock features of sandstone, shale or limestone, typically ledges and overhangs, but also talus. The Cheat River Canyon population of *P. panselenus* is disjunct from other populations of this species in southern West Virginia, Virginia, and Tennessee (Hotopp, 2006).

Table 1. Land snails of the Cheat River Canyon, West Virginia. Taxonomy follows Millard (2003) and Roth (2003). Common names follow Turgeon et al. (1998).

Species	Common Name
Order Vetigastropoda	
Helicinidae	
Hendersonia occulta (Say, 1831)	Cherrystone Drop
Order Basommatophora	
Carychiidae	
Carychium exiguum (Say, 1822)	Obese Thorn
Carychium exile I. Lea, 1842	Ice Thorn
Carychium nannodes G.H. Clapp, 1905	File Thorn
Order Stylommatophora	
Cionellidae	
Cochlicopa morseana (Doherty, 1878)	Appalachian Pillar
Polygyridae	
Allogona profunda (Say, 1821)	Broad-banded Forestsnail
Appalachina sayana (Pilsbry, 1906)	Spike-lip Crater
Euchemotrema fraternum (Say, 1824)	Upland Pillsnail
Mesodon thyroidus (Say, 1816)	White-lip Globe
Mesodon zaletus (A. Binney, 1837)	Toothed Globe
Neohelix albolabris (Say, 1816)	Whitelip
Neohelix dentifera (A. Binney, 1837)	Big-tooth Whitelip
Patera panselenus (Hubricht, 1976)	Virginia Bladetooth
Stenotrema edvardsi (Bland, 1856)	Ridge-and-valley Slitmouth
Stenotrema hirsutum (Say, 1817)	Hairy Slitmouth
Triodopsis platysayoides (Brooks, 1933)	Cheat Threetooth
Triodopsis tridentata (Say, 1816)	Northern Threetooth
Xolotrema denotatum (Férrusac, 1821)	Velvet Wedge
Punctidae	
Punctum minutissimum (I. Lea, 1841)	Small Spot
Punctum vitreum (H.B. Baker, 1930)	Glass Spot
Discidae	
Anguispira alternata (Say, 1816)	Flamed Disc
Discus patulus (Deshayes, 1830)	Domed Disc
Helicodiscidae	
Helicodiscus parallelus (Say, 1817)	Compound Coil
Helicodiscus shimeki Hubricht, 1962	Temperate Coil
Lucilla singleyana (Pilsbry, 1890)	Smooth Coil
Euconulidae	
Euconulus fulvus (Müller, 1774)	Brown Hive
Euconulus polygyratus (Pilsbry, 1899)	Fat Hive
Gastrocoptidae	
Gastrocopta armifera (Say, 1821)	Armed Snaggletooth
Gastrocopta contracta (Say, 1822)	Bottleneck Snaggletooth
Gastrocopta corticaria (Say, 1816)	Bark Snaggletooth
Gastrocopta pentodon (Say, 1821)	Comb Snaggletooth
Order Stylommatophora (continued)	
Truncatellinidae	
Columella simplex (Gould, 1841)	High-spire Column
Strobilopsidae	
Strobilops aeneus Pilsbry, 1926	Bronze Pinecone
Strobilops labyrinthicus (Say, 1817)	Maze Pinecone
Vertiginidae	
Vertigo bollesiana (E.S. Morse, 1865)	Delicate Vertigo
Vertigo gouldi (A. Binney, 1843)	Variable Vertigo
Gastrodontidae	
Striatura exigua (Stimpson, 1850)	Ribbed Striate
Striatura ferrea E.S. Morse, 1864	Black Striate
Striatura meridionalis (Pilsbry & Ferriss, 1906)	Median Striate
Striatura milium (E.S. Morse, 1859)	Fine-ribbed Striate
Ventridens arcellus Hubricht, 1976	Golden Dome
Ventridens demissus (A. Binney, 1843)	Perforate Dome
Ventridens intertextus (A. Binney, 1841)	Pyramid Dome
Ventridens ligera (Say, 1821)	Globose Dome
Zonitoides arboreus (Say, 1816)	Quick Gloss
Zonitoides nitidus (Müller, 1774)	Black Gloss
Pristilomatidae	
Hawaiia minuscula (A. Binney, 1840)	Minute Gem
Arionidae	
Arion subfuscus (Draparnaud, 1805)	Dusky Arion
Philomycidae	
Megapallifera mutabilis (Hubricht, 1951)	Changeable Mantleslug
Pallifera dorsalis (A. Binney, 1842)	Pale Mantleslug
Philomycus carolinianus (Bosc, 1802)	Carolina Mantleslug
Philomycus flexuolaris Rafinesque, 1820	Winding Mantleslug
Philomycus togatus (Gould, 1841)	Toga Mantleslug
Haplotrematidae	
Haplotrema concavum (Say, 1821)	Gray-foot Lancetooth
Succineidae	
cf *Catinella vermeta* (Say, 1824)	Suboval Ambersnail
cf *Novisuccinea ovalis* (Say, 1817)	Oval Ambersnail
Zonitidae	
Glyphyalinia cumberlandiana (G.H. Clapp, 1919)	Hill Glyph
Glyphyalinia indentata (Say, 1823)	Carved Glyph
Glyphyalinia rhoadsi (Pilsbry, 1899)	Sculpted Glyph
Glyphyalinia wheatleyi (Bland, 1883)	Bright Glyph
Guppya sterkii (Dall, 1888)	Granule
Mesomphix cupreus (Rafinesque, 1831)	Copper Button
Mesomphix inornatus (Say, 1821)	Plain Button
Mesomphix perlaevis (Pilsbry, 1900)	Smooth Button
Nesovitrea electrina (Gould, 1841)	Amber Glass
Paravitrea multidentata (A. Binney, 1840)	Dentate Supercoil
Paravitrea petrophila (Bland, 1883)	Cherokee Supercoil

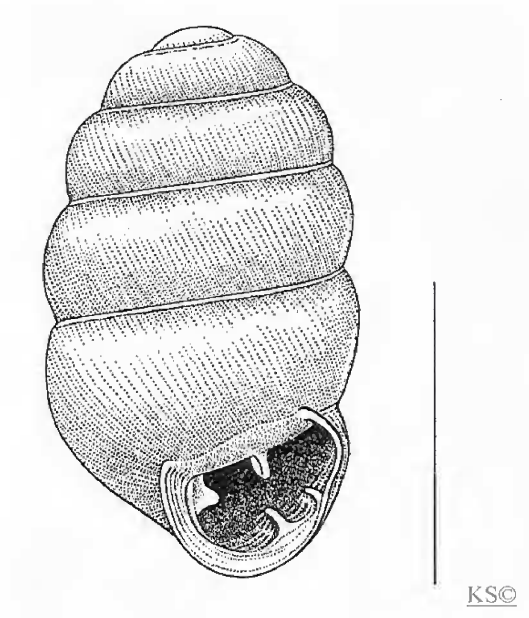

Fig. 3. *Vertigo bollesiana*, drawing by Kathleen Schmidt ©. The scale bar is 1 mm.

DISCUSSION

With 66 known species, the land snail fauna of the Cheat River Canyon harbors 41% of the approximately 160 species (MacMillan, 1949; Hubricht, 1985) found in West Virginia. Several central Appalachian Mountain endemic species are present. More extensive work would be needed to quantify the extent to which the land snail fauna of this canyon is exceptionally diverse or regionally unique, though the canyon does appear to be geologically distinct (relatively deeper and larger than nearby river valleys) and it is the only place in the world where *Triodopsis platysayoides* occurs.

For land snails of potential conservation interest, five are species restricted to the central and southern Appalachian Mountains. Their distributions in West Virginia are not completely known but they are not widespread. Two other species that are locally uncommon but that are more widely distributed in eastern North America were also included in this group. MacMillan (1949) reported West Virginia occurrences by county for five of these species of potential conservation interest; *H. occulta* from six counties; *P. petrophila* from six counties including Monongalia; *S. edvardsi* from 12 counties; *T. platysayoides* from Monongalia County; and *V. bollesiana* from three counties. The remaining two species were described after 1949.

Our species total approaches other reports of species-rich land snail assemblages. The geographically much larger Hiwassee River basin in Tennessee has 86 confirmed land snail species (Coney et al., 1982). Also larger, 22 counties along the western side of Lake Michigan had 82 species (Nekola, 2003). In Africa, a 1 km^2 patch of rainforest in Cameroon had 97 species (deWinter & Gittenberger, 1998). Smaller sites at Amboni Cave and near Amani in eastern Tanzania had 50 and 48 species, respectively (Emberton et al., 1997). By comparison, low species richness is found in areas such as the Southern Plains of Oklahoma and New Mexico, which had 26 species (Theler et al., 2004). Northwestern Minnesota was found to have 54 species (Nekola, 2002). In Europe, oligotrophic forest sites across southern Sweden yielded 38 species (Wäreborn, 1969), whereas calcareous woodlands across southern Britain harbored 57 species (Cameron et al., 2006).

Ultimately, however, simple comparisons of species richness between studies are difficult because of differences in methodologies and the geographic scale of inventoried areas. Also, such comparisons are of limited value by themselves, because they do not account for the identity of species, especially those that might be rare, endemic, or ecologically important.

We expect that further inventory work will expand and refine the list of land snails present in the Cheat River Canyon and nearby portions of the Cheat River watershed. There are several species for which identification is challenging and some for which taxonomy is uncertain. Smaller zonitid snails in genera such as *Glyphyalinia*, *Hawaiia*, and *Paravitrea* are in species-rich families with shells that are notoriously difficult to identify. For several species we had only a small number of specimens from which to make determinations. Identification of Succineidae snails is difficult without dissection or genetic analysis (Hoagland & Davis, 1987), which we did not perform. We have attempted to be conservative in this preliminary list by reporting only those species that are already described, and on whose identity we agree. We look forward to future discoveries in this valley and throughout the Cheat River watershed.

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